

## REMARKS

The Applicants thank the Examiner for the careful examination of this application and respectfully request the entry of the amendments indicated hereinabove.

This 116 Amendment is submitted in order to respond to the Examiner's Office Action dated 8/25/03 and to prepare this case for appeal. Claims 1, 4-13, and 16-39 are pending and rejected. Claims 4 and 16-29 are cancelled, Claims 51-68 are added, and Claims 1 and 5 are amended hereinabove.

The Applicants respectfully traverse the rejection of Claims 1, 4-13, and 16-39 under 35 U.S.C. §112, first paragraph. The Applicants submit that wording "also subjecting the semiconductor wafer to a dry plasma" in Claim 1 is described in the Specification. Namely, the Specification clearly states on page 11 lines 14-15 that the anneal may be performed with "the same tool" as that used for step 106 (which is a dry plasma tool). The Applicants also note that on page 11 line 23 the term "nitrogen-containing plasma" is a clear indication that step 110 is a plasma step. Claim 1 has been amended hereinabove to use the term "plasma anneal" to avoid further confusion, even though the Applicants submit that those persons knowledgeable in the art would not be confused by the prior wording of Claim 1.

Claim 30 positively recites the step of removing the polymeric residue by subjecting the semiconductor wafer to a wet etch chemistry. These

advantageously claimed features are not taught or suggested by the patent granted to Kropewnicki et al.

The Applicants respectfully traverse the statement in the Office Action that Kropewnicki et al. teaches the use of wet etch chemistry for removing the polymeric residue. Kropewnicki et al. teaches away from the use of wet cleans (col. 1, lines 48-58) while teaching the use of a dry clean process (col. 1, line 66 through col. 2, line 44). More specifically, Kropewnicki et al. considers the wet clean process undesirable; stating (column 1 lines 44-57) that the wet clean process requires a solvent that is costly and hazardous to the environment, contributes to lower yield because the substrate is contaminated in the transferring operation, and oxidizes contact/junction points. Furthermore, the Applicants submit that the EKC 265 solvent listed in column 1 line 46 is not capable of removing the polymeric residue on the first material of Claim 30. Specifically, the MSDS for EKC 265 reveals that it contains 2-(2-Aminoethoxy) ethanol plus hydroxylamine plus catechol. Therefore, EKC 265 is very inferior to the advantageously claimed mixture at removing the type of polymer found on wafers after dielectric etch and resist removal.

The Applicants respectfully traverse the statement in the Office Action that "clearly in col. 2, lines 1-10, the polymeric residue can be removed by using either a wet or dry chemistry." Clearly, NH<sub>3</sub> is used in Kropewnicki et al. as a gas component of a plasma process. Specifically, the Kropewnicki et al. patent describes the use of NH<sub>3</sub> gas in a plasma as an additive to a mostly O<sub>2</sub> plasma for

resist and residue removal. There is no mention of using a wet process in that portion of the Kropewnicki et al. patent.

Kropewnicki et al. describes the use of an etching chamber to remove the photoresist and post etch and ash polymeric residues (i.e. col. 2, lines 36-44). The Applicants downstream plasma tool (page 9 lines 13 – 17) operates in a completely different regime that includes higher process pressure, much higher gas flows, much higher temperatures, and no biasing of the wafer. Conversely, Kropewnicki et al requires biasing of the wafer (col. 2, line 22). The Applicants submit that the Kropewnicki et al. process produces substantial damage to low-k dielectric material.

Therefore, the Applicants respectfully traverse the Examiner's rejection of Claim 30 and respectfully assert that Claim 30 is patentable over Kropewnicki et al. Furthermore, Claims 31 - 39 are allowable for depending on allowable independent Claim 30 and, in combination, including limitations not taught or described in the references of record.

The Applicants respectfully traverse the statement in the Office Action that "mixing the inorganic acid with an organic acid to obtain a wet etching mixture is considered an obvious design optimization." The Applicants submit that the combination of hydrofluoric acid with an organic acid was not obvious at the time of the invention. In fact the assignee was considered an expert in the field of residue removal then and now, and the advantageously claimed invention represents many months of effort on the part of the Applicants. Furthermore, the Applicants

submit that if such a combination was "obvious", than the Examiner should be able to provide art that teaches the advantageously claimed mixture.

Claims 51-59 have been added hereinabove. These claims are closely related to original claims 40-50 filed in the initial patent application.

Claim 60 has also been added hereinabove. It is closely related to currently pending Claim 1. Lastly, Claims 61-68 have been added hereinabove. These claims are closely related to original claims 1, and 21-29 filed in the initial patent application.

For the reasons stated above, this application is believed to be in condition for allowance. Reexamination and reconsideration is requested.

Respectfully submitted,



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